

CHAPTER 2

COMPUTER SYSTEM

2. Computer System

2.1 Introduction

A computer system, for being useful has to communicate with its environment through some means known as Computer Peripherals or Input/output Devices. Computer peripherals may be divided into three broad categories namely **Input Devices**, **Output Devices** and **Input/output Devices**.

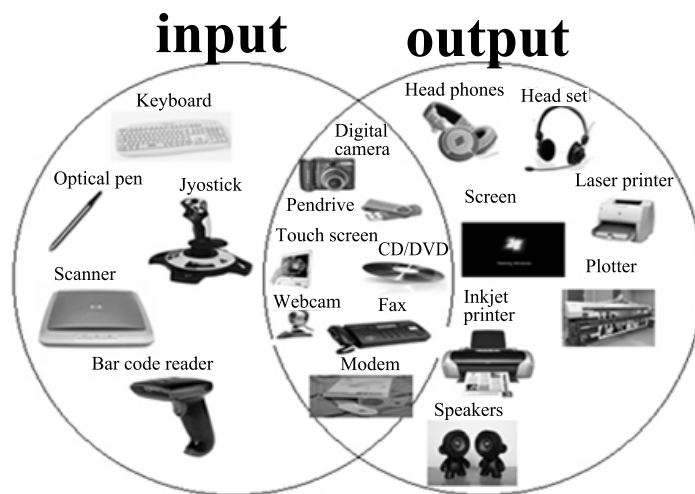


Figure 2.1 Input/output Devices

2.2 Input Devices

2.2.1 Keyboard

The computer keyboard is most commonly used input device to enter number, alphabets and special characters into the computer. The keyboards are also used to type in the commands to direct the computer to perform certain tasks. A keyboard has alphabetic and numeric keys for

entering the text and numeric data. There are a certain number of editing keys and a number of function keys which are used to invoke function directly. The Caps Lock / Num Lock / Scroll Lock Key is called Toggle keys and used to turn on/off the feature. The Ctrl / Alt Keys are called Combination key which allows certain operation by pressing along with other keys. Most of the keyboards come with separate numeric Pad/section to enter numerical values.

2.2.2 Pointing devices

The graphical user interfaces (GUIs) which are extensively used require some kind of devices for positioning the on-screen cursor. Some common pointing devices are: **mouse, trackball, touch pad, track point, graphics tablet, and joystick and touch screen**. Pointing devices are connected to a PC via a USB port.



Figure 2.2 Keyboard

2.2.2.1 Mouse

The mouse is most popular pointing device used by users with one hand. In older mouse, a ball in the bottom of the mouse rolls on the surface as we move the mouse and internal rollers sense the movement of ball and transmit the information to the computer through the mouse cord. The modern optical mouse does not use a rolling ball, but instead use a light and small sensor to detect the motion of the mouse by tracking a small image of the desk surface. A cordless or wireless mouse interconnects with the computer via radio waves.



Figure 2.3 - Mouse

A mouse may also include scroll wheels, to enable users to work together with GUI (Graphical User Interface). The traditional PC Mouse has two buttons while the Macintosh mouse has one button.

2.2.2.2 Touch Pad

Most of the laptops are equipped with a touch pad pointing device. User moves the on screen cursor by sliding his/her finger along the surface of the touch pad. The left/right Click buttons are located below the pad. Touch pads have advantage over mouse that they take much less room to use. Also they don't have any moving parts.

2.2.2.3 TrackPoint

Some sub-notebook computers such as IBM ThinkPad which lack room even for a touch pad, incorporates a TrackPoint, a small rubber projection embedded amid the keys of the keyboard. The TrackPoint acts like a small joystick that can be used to control the position of the cursor.

2.2.2.4 Trackball

The trackball is like an upside-down mouse, with the ball located on the top. We use fingers to roll the trackball and internal rollers sense the motion which is transmitted to the computer. Trackball has the advantage over Mouse is that the body of the trackball remains stationary on the desk; we don't need much room to use the trackball. Nowadays optical trackballs are available which don't have rollers and there is no problem of dirt in its wheels.



Figure 2.4 - Touch Pad

2.2.2.5 Joysticks

Joysticks and other common game controllers can also be associated to a computer as pointing device. They are generally used for playing games.



Figure 2.5 - Joy Sticks

2.2.2.6 Graphics Tablet

A graphics tablet contains an electronic writing area and a special pen which works using it. Graphics tablets allow the artists to create graphical images with motions and actions similar to using more traditional drawing devices. The pen of the graphics tablet is pressure sensitive, so pressing harder or softer can result in brush strokes of different width.



Figure 2.6 - Graphics Tablet

2.2.3 Scanners



Figure 2.7 - Scanners

A scanner is a device that enters the printed page or graphic in computer by digitizing it, producing an image made of tiny pixels of diverse brightness and color values which is sent to the Computer.

It uses laser technique to convert the printed information into the Electronic format. The Information being scanned can be anything like handwritten text, images, diagrams etc. Once scanned it can be stored in Computer or printed through a Printer.

2.2.4 Midi Devices

MIDI (Musical Instrument Digital Interface) is a system intended to transmit information between electronic musical instruments. A MIDI musical keyboard can be connected to a computer and permit a performer to play music that is captured by the computer system as a sequence of notes with the associated timing.

2.2.5 Magnetic Ink Character Recognition (MICR)

Magnetic Ink Character Recognition Code (MICR Code) is a character-recognition technology used mainly by the banking industry to ease the processing and clearance of cheques and other documents. It converts them into digital data for understanding of computer.

2.2.6 Optical Mark Reader (OMR)

These are special scanners to scan and identify a pre-specified type of marks (human-marked data) made by Pencil or Pens. Most common example is answer sheets used in the examinations, OMR is used to scan the answer sheets and produce result as output. OMR is also used in surveys, polls and tests.

2.2.7 Optical Character Recognition (OCR)

Optical character recognition (optical character reader) (OCR) is the electronic conversion of images of typed, handwritten or printed text into machine-encoded text. It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation. It is most common method of digitizing printed texts so that it can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech, key data and text mining.

2.2.8 Bar Code Reader

Bar Code is a machine readable data representation of an object and is used to identify an object uniquely. Originally barcodes represented data by varying the widths and spacings of parallel lines but later they evolved into rectangles, dots, hexagons and other geometric patterns in two dimensions (2D). These are specifically used in shopping malls and departmental stores for quick billing and inventory management. A Special handheld device (Bar Code Reader) connected to a computer/terminal is used to read the code and identify the item.

2.2.9 Speech Recognition Device (Microphone)

Microphone is an input device used to input audio data into a computer. It is connected to a computer system through a single wire and users may use a mouthpiece shape like device to capture the audio.

2.2.10 Webcam (Web Camera)

This is a digital camera connected to the computer and can feed images / videos to computer networks through the computer. The camera is focused on the input item to take a picture and convert it to a machine readable format for storing in a computer system.

2.3 Output Devices

2.3.1 Monitor

To produce a soft copy of output, the most popular device is a Monitor. It allows users to view/read the output on a Computer Screen.

2.3.1.1 CRT Monitor

The classical output device of a personal computer has been the CRT monitor. It is just like a TV set. A CRT monitor encompasses a big cathode ray tube that uses an electron beam of varying power to “paint” a picture onto the color phosphorescent dots on the inside of the screen. Monitor screen size is measured diagonally across the screen, in inches. The resolution of the monitor is maximum number of pixels it can display horizontally and vertically such as 800X600, 1024X768 etc. Pixels are the small dots that make the image displayed on the screen. The spacing of the screens tiny phosphor dots is called the dot pitch. A screen with smaller dot pitch produces sharper images.



Figure 2.8 - CRT Monitor

2.3.1.2 Flat Panel Monitor



Figure 2.9 - Flat panel Monitor

A flat panel monitor usually uses an **LCD (Liquid Crystal Display)** screen to show output from the computer. The LCD is made of several thin layers that polarize the light transmitting through them. The polarization of one layer, containing long thin molecules called crystal displays can be controlled electronically at each pixel, blocking varying amounts of the light to create a pixel lighter or darker. **LED (Light Emitting Diode)** and **Plasma Displays** are also flat panel technologies but LCDs are most popularly used in computers especially in laptops.

Flat panel displays are much lighter and less bulky than CRT monitors. The latest LCD screens use transparent thin film transistor (TFT) controlling each pixel, so the picture quality and viewing angle are much improved. LED monitors use light emitting diodes that act as a performance booster in the monitors. Basically LED monitors are the LCD monitors with a LED backlight to power up the LCD panel.

2.3.2 Printer

Printers provide information in a permanent readable format also known as Hard Copy. Usually output is printed on a paper. The printer output quality is measured in terms of DPI (Dots per Inches). The printers can be classified broadly into Impact and Non-Impact Printers.

2.3.2.1 Impact Printers

2.3.2.1.1 Character Printer

These types of printers usually print one character at a time. Most popular examples are Dot Matrix and Daisy Wheel Printers. Dot matrix printers are small electromagnetically activated pins in the print head, and an inked ribbon to produce images by impact. These printers are noisy and comparatively slow. These are used in big businesses where continuous printing is to be done on 80 columns and 132 columns stationary.



Figure 2.10 - Dot Matrix printer

2.3.2.1.2 Line Printer

A line printer prints a complete line at a time. Traditionally line printers were characterized as Chain Printers and Drum Printers. These types of printers use a print head consisting of pins which are moved by electromechanical mechanism to strike a ribbon placed between printer head and the paper where the output need to be printed. Their speed varies from 200 to 2000 lines per minutes depending on the type of printing properties.

2.3.2.2 Non-Impact Printers

Non-impact printers are usually faster than impact printers and work very quietly. They do not use a striking device to produce characters on the paper. Some of the popular non-impact printers are:

2.3.2.2.1 Ink jet Printers



Figure 2.11 - Ink jet Printers

The most common type of printer for home uses is Color Ink Jet Printer. These printers form the image of the page by spraying small droplets of ink from the print head. The printer needs several colors of ink to make color images. These printers are comparatively cheaper, but the cost of consumables makes them costly to operate in the long run.

2.3.2.2.2 Laser printer

A laser printer produces good quality images for office and business purposes. A drum coated with photosensitive material is charged, and then an image is written onto it by a laser or LED. The drum then rolls



Figure 2.12 - Laser printer

through the toner and the toner is then deposited onto the paper, and then fused into the paper with heat.

Most laser printers are monochrome (one color-black only) but more expensive laser printers with multiple color toner cartridges produce multi-color output. These printers are faster than ink jet printers; their speed is measured in pages per minute (ppm).

2.3.2.2.3 Thermal Printer

It uses heat elements to produce output on special papers. The most common use is in printing slips by ATMs. Heat sensitive paper is used. Printing cost is high and hence is being used for only professional arts and design works purpose.

2.3.2.2.4 Plotter

Plotters are used to print high quality vector graphics (engineering drawings, building plans, circuit diagrams etc.) under the control of computer. They use ink pens or inkjet to draw graphics or drawings. They are generally Drum Plotter and Flat Bed Plotter.

2.3.3 Speaker

It's a part of the multimedia computer. Speakers contain amplifiers which vibrate to produce the sound and gives audio output.

2.3.4 Multimedia Projector

To project the computer output to a large number of people, Multimedia Projectors are used. It is widely used for showing presentations inside corporations during team meeting.

2.4 Input / Output Devices

Many peripheral devices have the capability of being used as Input and Output devices both. Some of the popular I/O devices are listed below:

Fax machine: - The fax machine translates a document into a series of zeros and ones (also known as a bit map) that can be transferred like normal computer data. On the receiving side, a fax machine receive the incoming data, translates the zeros and ones back into dots, and reprints the picture. Thus serve as both Input and Output Device.

Multifunctional Devices (MFD):- It is a device that performs a variety of functions that would else be carried out by separate peripheral devices. A multifunction peripheral combine a minimum two of the following: a printer, a scanner, and a copier. Example of such device is a Multi-Functional Printer.

Modem: - it is a device which converts Analog signals received over the telephone line to Digital

signal which may be used as Input for a Computer. Similarly it transmits information received from a computer over the telephone lines.

Touch screen displays and digital Camera are few other examples of common input / output devices.

QUICK REVIEW

- What is the use of a joystick?
- Write the names of three input and three output devices?
- What is a scanner and how does it work?

USEFUL TIP

If you are getting an I/O error with a disc, try another disc in the computer to see if you get the same error. If the same error occurs, then you have a problem with the drive. If you can read another disc with no errors, then it may be a bad or dirty disc.

2.5 Computer Memory

A computer memory is just like a human brain. It is used to store data and information. Computer memory is the storage space where data and instructions which are to be processed are kept. Memory is primarily of three types: Cache Memory, Primary Memory / Main Memory and Secondary Memory

2.5.1 Cache Memory

Cache memory is a very high speed semi-conductor memory which may speed up the CPU and the main memory. It is used to contain those parts of data and program which are most frequently used by the CPU. The parts of data and programs are transmitted from disk to cache memory by operating system from where CPU can access them. The following are the **advantages of cache memory**:

- Cache memory is faster than the main memory
- It consumes less access time as compared to main memory
- It stores data for temporary use
- It stores the program that can be stored within a short period of time

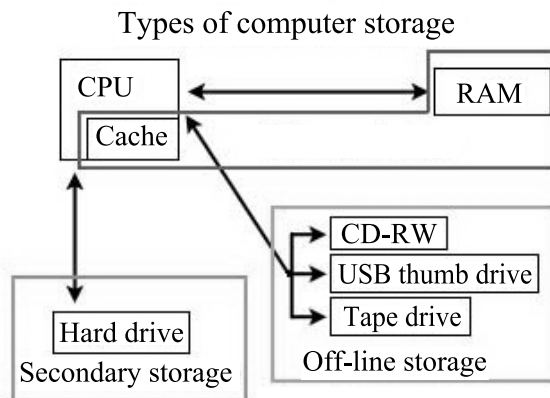


Figure 2.13 – Type of Computer Storage

There are certain disadvantages of cache memory:

- Cache memory has limited capacity
- It is very expensive.

2.5.2 Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which computer is working currently. The data in this memory is lost when the power is off. This memory is generally made up of semiconductor devices. It means integrated circuits consisting of silicon based transistors.

RAM (Random Access Memory) and ROM (Read Only Memory) are two examples of main memory. RAM is volatile memory. Samples of non-volatile memory are ROM / PROM (Programmable) / EPROM (Erasable PROM) and flash memory. The data and instructions required to be processed reside in the main memory. RAM and ROM are two examples of main memory. Additional characteristics of main memory are:

- It is the working memory of the computer
- Its speed is faster than the main memory
- A computer cannot run without primary memory

2.5.2.1 Random Access Memory (RAM)

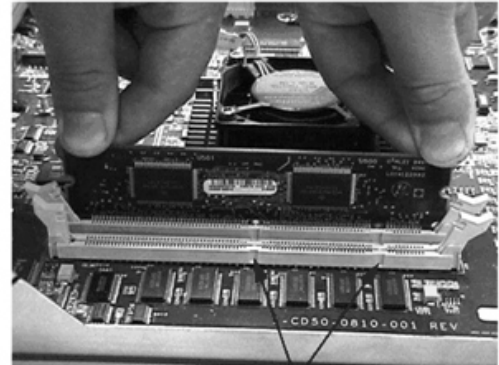
The read and write (R/W) memory of computer is called computer memory. The user can read as well as write information to it. With RAM any location can be reached after specifying the address of the location.

RAM is considered “random access” because we may access any memory cell directly if we know the address. The transistors make up the individual storage cells which can each remember an amount of data. There are two types of basic RAMs:

- a. Dynamic RAM (DRAM)
- b. Static RAM (SRAM)

The term static differentiates SRAM from DRAM which must be periodically refreshed. SRAM is faster and more costly than DRAM; it is commonly used for CPU cache while DRAM is used for a computer's main memory. Some other forms of RAM are:

- a. EDO (extended Data Output) RAM- in EDO RAMs, any memory location can be accessed. It stores 256 bytes of data information into latches.
- b. SDRAM (Synchronous DRAMs): These RAM chips use the same clock rate as the CPU



Key notches

Figure 2.14 - Cache Memory

uses.

- c. **DDR-SDRAM (Double Data Rate- SDRAM):** This RAM transmits data on both edges of the clock.

2.5.2.2 Read Only Memory (ROM)

It is non-volatile memory. The information stored on it is not lost, even when power goes off. It is used for permanent storage of information. The information on ROM cannot be altered. Whatever is stored on it by the manufacturer, it remains fixed.



Figure: 2.15 Read Only Memory (ROM)

The following are the types of ROMs:

- a. **PROM:** It is Programmable Read Only Memory. Its contents are decided by the user. The user can store permanent programs. The data is fed into it using PROM programs.
- b. **EPROM:** It is an erasable PROM. The stored information on EPROM's can be erased by exposing it to UV rays in about 15 minutes. It is not possible to erase a part of it, but the entire contents are to be removed. EPROM's are cheap and reliable.
- c. **Flash Memory:** It is an electrically erasable and programmable permanent type of memory. It uses transistor memory, all resulting in high packing density, low power consumption, low cost and higher reliability. It is used in digital cameras, MP3 players.

2.5.3 Secondary Memory



Figure: 2.16 Secondary Memory (DVD)

Secondary Memory is also known as external memory or non-volatile memory. It is slower than the main memory. It is used for storing data and information permanently. CPU does not access secondary memory directly; rather they are retrieved via input-output routines. Contents of secondary memory are first transferred to main memory, and then CPU can access it.

Characteristics of Secondary memory:

- These are optical and magnetic memories. (Used as Back Up Memory)
- Data is permanently stored, even when the power is switched off. (non-volatile memory)
- Slower than primary memories
- Large and voluminous data may be stored

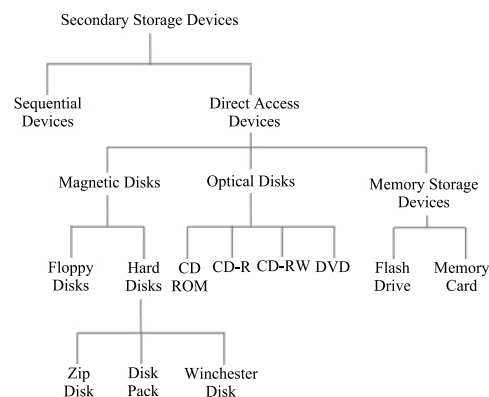


Figure: 2.17 Secondary Memory Classification

without much cost involvement. (e.g. Hard Disk)

2.5.3.1 Hard Disk, Hard Disk Drive



Figure 2.18 - Hard Disk

It is a data storage device used for storing and retrieving digital information using one or more fast rotating disks covered with magnetic material. The platters are paired with magnetic heads arranged on a moving arm, which read and write information to the platter surface. Data is accessed in a random access manner that means the data can be accessed in any sequence. An HDD retains its data even when the power is off.

The primary characteristics of HDD are its capacity and performance. A terabyte (TB) drive has a capacity of 1000 gigabyte (GB) where 1 GB= 1 billion bytes. Performance is specified by the time taken by it to retrieve the data i.e. the data rate.

2.5.3.2 Optical Disks

All optical disks are circular shaped platters. These come in different size and storage capacity. The most popular optical disk types are WORM (CD-R), CD-RW, DVD and Blu-Ray Discs.

	Capacity	Layer	Recordable	Rewriteable
CD-R	650-700MB	1	•	
CD-RW	650-700MB	1		•
DVD-ROM	4.7GB	1		
DVD+R	4.7GB	1	•	
DVD+RW	4.7GB	1		•
DVD+R DL	8.5GB	2	•	

Figure2.19 – Comparison of Optical Disk

2.5.3.2.1 WORM Disk / CD Recordable Disk

WORM Means Write Once, Read Many Disks or Compact Disc-Recordable (CD-R). Using a CD recording drive one can store data on WORM Disk/CD-R Disks only once. Data in these disks are written by creating pits on the disk surface by shining a laser beam for reading.

2.5.3.2.2 Compact Disc-Read/Write (CD-RW)

It is similar to a WORM Disk however you can wipe out and re-write the information multiple times.

2.5.3.2.3 Digital Versatile Disc (DVD)

It is an optical storage device that looks same as CD with a storage capacity up to 4.7 GB - 8.5 GB of data. DVD's may be classified as single layer disk or double layer disk. It is most popularly used for storing high quality movies and audio files.

2.5.3.2.4 Blu-Ray Disc

It is expected to replace existing DVD's in the future. These discs also use a laser beam for recording with the additional capability to store high density data. It has the storage capacity varying from 50 GB to 500 GB.

USEFUL TIP

How to determine available hard drive space on a PC?

Open the Computer Icon or press the shortcut key Windows Key + E. In Computer you will see each drive with a small percentage bar of how much disk space is being used as well as a description of how much is free and the total disk space. If you need additional information, right-click the disk drive and click on Properties.

2.5.3.2.5 Pen Drive/ Flash Memory

It uses a small portable device which can be connected to a computer through USB Port. It can retain data even when it is not connected to a computer. It is very easy to disconnect and carry anywhere safely.

2.5.3.2.6 SmartMedia Card

It's most popularly being used in Digital Camera these days and is like a portable credit card.

2.5.3.2.7 Secure Digital Card (SD Card)

They are second generation Multimedia Card. It has the ability to lock and protect the data from being used. It has two variants:

- **MiniSD** Card: This is used to meet the requirement storing data in smart phones.
- **MicroSD** Card: It is smaller than MiniSD Memory card with all the features as available in Mini SD.

QUICK REVIEW

- What is computer memory
- Differentiate between RAM and ROM.
- What is secondary memory? How a CD ROM works?

2.6 Computer Classification

Computers may be classified based on their data processing capabilities. They are categorized according to purpose, data handling, functionality, size, storage capacity and performance.

2.6.1 Classification based on Operating Principles

According to operating principles and data handling, computers can be classified into following three categories: Analog, Digital and Hybrid Computers

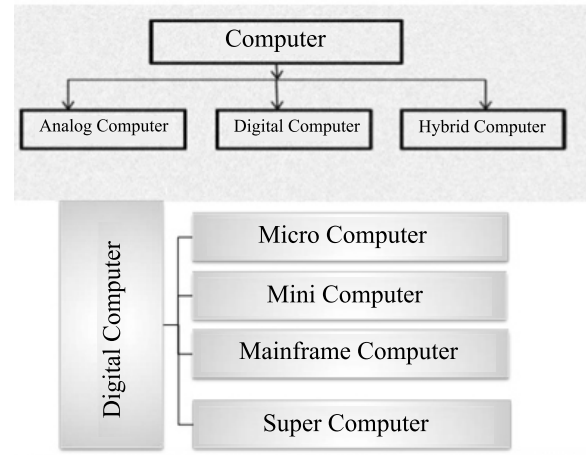


Figure2.20 – Classification of Computers

2.6.1.1 Analog Computers

Analog computers work on the principles of measuring, in which the measurements gained are translated into data. These are used to measure quantities like voltage, temperatures, current etc. These computers do not operate on numbers directly.



Figure 2.21: Analog Computers

2.6.1.2 Digital Computers

These computers operate with information in the digital form. These computers operate with more accuracy and faster rate. These operate by counting. These computers are used for all general purpose applications and are used for voluminous data processing work.



Figure 2.22: Digital Computers

2.6.1.3 Hybrid Computers

These computers exhibit features of both Digital and Analog computers. A hybrid computers system setup offers a cost effective method of performing complex simulations. These computers serve as controller and provide logical operation.

2.6.2 Classification based on Size, Storage Capacity and Performance

Computers can be very big as large as a big room and as small as a laptop or a micro controller in a mobile and embedded system. The four basic types of computers are Super, Mainframe, Mini and Micro Computer.

2.6.2.1 Super Computer

These are the most powerful computers in terms of data storage, performance and data processing. These computers are exceptional computers and are used for large research and scientific purposes. Like NASA is using these computers for launching space shuttles, controlling them and for space exploration purposes. These computers require lot of space for functioning and are extremely expensive. The first supercomputer was designed in 1964 namely CDC 6600.

Applications of Super Computers:

- **Weather forecasting:** These computers are used to predict and study weather forecasting and to analyze the nature and extent of rainfalls, windstorms.
- **Earthquake studies:** Supercomputers are also used for exploring the earthquake phenomenon. They are used for resource exploration like natural gas, petroleum and coal.
- **Communication:** These computers are also very useful in enhancing the communication between different devices, different machines and between different individuals.



Figure2.24 - Super Computers

There are many other uses like weapon simulation and for knowing the impact of nuclear weapons. Some popular supercomputers are:

- IBM's Sequoia in US
- Fujitsu's K Computer in Japan
- PARAM Super computer in India

2.6.2.2 Mainframe Computers

These computers are also very expensive and are used by government organizations, large business firms and for business operations. These computers are kept in big rooms with appropriate cooling and other facilities. They can process a large volume of data at a very high speed. Big business banks, educational institutions and insurance companies use mainframe computers to store data of their customers.



Figure 2.25 - Mainframe Computer

Some popular mainframe computers are:

- Fujitsu's ICL VME
- Hitachi's Z800

2.6.2.3 Mini Computers

Mini computers are used by comparatively small business houses. Although they are not as powerful as super computers and mainframe computers, but still they are very powerful machines. These are used by big or middle range companies and production houses. These computer uses a single user and a multi user concept also. Some examples of mini computers are:

- K-202
- Texas Instrument TI-990
- SDS-92.

2.6.2.4 Micro Computers

Desktop computers, laptops, PDAs, tablets and smart phones are all types of microcomputers. These computers are widely used and are fastest growing computers. These are cheapest amongst the all four basic type computers. These computers are general purpose computers and are used for education, entertainment and other office purposes.

QUICK REVIEW

- How do we classify computers based on speed, storage and performance
- Difference between a Personal Computer and Super Computer
- What is the name of India's first Super Computer?

Multiple Choice Questions

1. Daisy wheel printer is a type of:
a. Matrix printer b. Impact printer
c. Laser Printer d. Manual
2. Which of the following memories must be refreshed many times per second:
a. Static RAM b. Dynamic RAM
c. EPROM d. ROM
3. Which memory is used to store most frequently accessed information from the RAM?
a. Cache Memory b. Main Memory
c. Register d. ROM
4. An optical input device that scan and reads pencil marks on paper media is:
a. OMR
b. Punched Card Reader
c. Magnetic Tape
d. Optical Scanner
5. Which form of memory is volatile in nature?
a. RAM b. ROM
c. PROM d. EPROM
6. Which type of ROM can be erased by an electrical signal?
a. ROM b. Mask ROM
c. EPROM d. EEPROM
7. Which of the printers used in conjunction with computers uses toner (dry ink powder)?
a. Daisy wheel printer
b. Line printer
c. Laser printer
d. Thermal printer
8. Which of the following produces the best quality vector graphics?
a. Laser printer b. Ink jet printer
c. Plotter d. Dot matrix printer
9. Which is the fastest computer?
a. Mainframe
b. Minicomputer
c. Workstations
d. Super Computer
10. DPI Stands for?
a. Dot per inch
b. Dot per sq. inch
c. Dots printed per unit time
d. All of above